

In the case of the heavy rainfall over the Mississippi Valley in the winter of 1949, it is even more difficult to judge the effect of cloud seeding on the over-all weather pattern. Even if silver iodide does remain an efficient seeding agent for long intervals and over large distances, it is virtually impossible to evaluate the horizontal and vertical transport, and, hence, the contingent distribution and concentration of the silver iodide through the atmosphere when the distances involved are as great as those between New Mexico and the Mississippi Valley. On the other hand, it can be said with certainty that the patterns of weather and rainfall over the United States during this period were quite similar to a number of corresponding periods in the past, and that they fit very naturally and normally into the rather unusual Northern Hemisphere weather pattern of that period. To anyone who is fully aware of the world-wide character of the mechanics of the large-scale wind systems and of the apparently secondary and incidental role of rainfall distribution in the world-wide meteorological pattern, the implication that the purported artificial production of precipitation in the Mississippi Valley significantly modified this pattern seems fantastic. It is impossible, however, either to verify or to disprove Langmuir's contention in this respect from his analysis of the data as presented to us.

The other approach to the problem of determining the effect of cloud seeding on rainfall is primarily statistical. In the case of the Albuquerque experiments such an approach involves a careful consideration of the striking similarity of the rainfall patterns during the two days on which the allegedly successful experiments were conducted, particularly an investigation of the odds against the occurrence of such a degree of similarity by chance alone. In order to accomplish a reliable determination of these odds, a complete analysis of the entire situation should be made, starting with an objective analysis of original data pertaining to moisture distribution, winds, and rainfall in relation to topography. (Topography alone could be expected to produce a certain similarity in precipitation patterns on different days.) In addition, it would be necessary, because of the amount of serial correlation that occurs in weather patterns, and also the similarity that oftentimes exists between patterns, to determine from a study of climatological records what are the probabilities of such an occurrence of agreement between patterns. As far as we have been able to discover, however, these necessary statistical precautions were not taken in the original analysis of the two Albuquerque experiments. Therefore, we cannot accept as proved the odds against chance occurrence that have been cited by Langmuir. It is our considered opinion that the artificial production of substantial amounts of rainfall over an area of the order of 100,000 square miles definitely has not been demonstrated in these two cases.

A similar statistical approach must be made in order to achieve an effective evaluation of the high

correlation between the days on which silver iodide "smoke" was released at Socorro, New Mexico, and the subsequent occurrence of rainfall in the Mississippi Valley. On the basis of a purely random situation this high correlation between the release of silver iodide and the rainfall probably is significant, but because of the general statistical behavior of rainfall patterns the situation in question should be carefully compared with the behavior of previous cases of abnormally heavy winter rainfall in that vicinity to see whether the periodicity exhibited in the present case is a likely occurrence by pure chance. Since, to the best of our knowledge, such a comparison has not yet been undertaken by Dr. Langmuir, we cannot accord credence to the sweeping inference that the abnormal character of the basic weather pattern was the result of the silver iodide operations at Socorro.

GARDNER EMMONS

Research Division, College of Engineering
New York University

BERNHARD HAURWITZ

Department of Meteorology, College of Engineering
New York University

GEORGE P. WADSWORTH

Department of Mathematics
Massachusetts Institute of Technology

HURD C. WILLETT

Department of Meteorology
Massachusetts Institute of Technology

Scientific Book Register

The Population of India and Pakistan. Kingsley Davis. Princeton, N. J.: Princeton Univ. Press, 1951. 263 pp. \$7.50.

Lehrbuch der Theoretischen Physik: Struktur der Materie, Vol. II. Walter Weizel. West Berlin, Germany: Springer-Verlag, 1950. Pp. 772-1,540. DM 69.90 bound, DM 66 paper.

Of Societies and Men. Caryl P. Haskins. New York: Norton, 1951. 282 pp. \$4.50.

London Essays in Geography. Rodwell Jones Memorial Volume. L. Dudley Stamp and S. W. Woolridge, Eds. Cambridge, Mass.: Harvard Univ. Press, 1951. Published for The London School of Economics and Political Science. 351 pp. \$5.00.

The Invertebrates: The Acoelomate Bilateria, Platyhelminthes and Rhynchocoela, Vol. II. Libbie Henrietta Hyman. New York: McGraw-Hill, 1951. 550 pp. \$9.00.

Plant Embryology: Embryogeny of the Spermatophyta. Donald Alexander Johansen. Waltham, Mass.: Chronica Botanica; New York: Stechert-Hafner, 1950. 305 pp. \$6.00.

Mathematical Engineering Analysis. Rufus Oldenburger. New York: Macmillan, 1950. 426 pp. \$6.00.

Oeuvres Complètes de Christian Huygens: Supplément, à la Correspondance, Varia, Biographie de Chr. Huygens, Tome XXII. The Hague, The Netherlands: Martinus Nijhoff, 1950. Published for the Société Hollandaise des Sciences. 921 pp.

Elements of Bacterial Cytology. 2nd ed. Georges Knaysi. Ithaca, N. Y.: Comstock, 1951. 375 pp. \$5.00.